

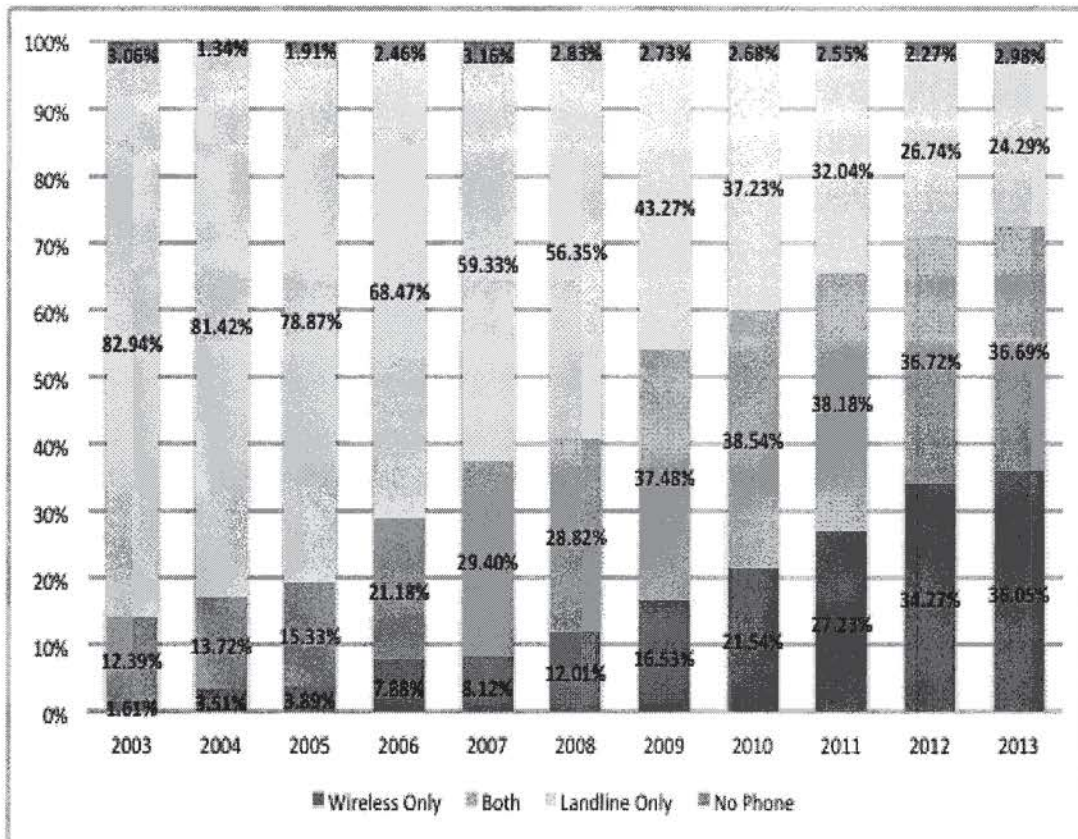
22. Three facts regarding the elderly and wireless telephony are readily transparent in Figure 3. First, the adoption of wireless telephony by the elderly has been pronounced, especially over the past decade. Although cellular telephony was first introduced in 1983, twenty years later only 41 percent of elderly households possessed wireless subscription service in 2003. But by 2013, wireless adoption among the elderly has grown to 85 percent. Over four out of five elderly households today possess wireless service as an alternative to traditional landline service.

23. Second, the growth of wireless-only elderly households has been significant: from one percent in 2003 to over 25 percent by the end of 2013. Fully one-quarter of elderly households have become wireless-only, and the growth path of wireless-only elderly households is along the same path as the larger population of households, but with a slight lag. While it is still true that the level of wireless-only elderly households is lower than the average across the general population of other U.S. households, this demographic segment is indeed embracing the wireless revolution and “catching up” to the younger population.

24. Third, complementing the move by elderly households toward wireless services, we find that the percentage of these households that rely exclusively on landline telecommunications has fallen dramatically: from 58 percent in 2003 to under 14 percent by the end of 2013. These data indicate that elderly households are not economically yoked to traditional wireline telephone subscriptions.

25. A final “but what about” issue concerns the confluence of the elderly and the poor. That is, a particular concern may arise about the vulnerability of poor, elderly households to the consequences of regulatory flexibility by incumbent local exchange carriers. Figure 4 provides comfort about this concern as it reveals a ready willingness of poor elderly households to shift from wireline to wireless telephony. Among the nominally most vulnerable elderly households—those living in poverty—we find that roughly 36 percent have “cut the cord” by dropping their landline telephone subscription all together. And exclusive reliance among these households on traditional wireline telephone subscriptions has fallen precipitously from 83 percent to 24 percent in the last decade.

FIGURE 4
HOUSEHOLDS WITH WIRELINE, WIRELESS, BOTH OR NEITHER
AMONG HOUSEHOLDS WITH HEAD OF HOUSEHOLD OVER 50 YEARS OLD
AND BELOW POVERTY THRESHOLD
2003-2013



26. In sum, the data that we have examined provide considerable comfort that elderly households are not as economically vulnerable as some may fear or have posited. Indeed, elderly households—similar to all other U.S. households—appear to increasingly see value in wireless services and are transitioning rapidly to adopt a portfolio of wireless and landline telephones. While regulatory reform in landline telecommunications needs to be sensitive to potentially vulnerable segments of society, it should not be sidetracked by empty concerns.

While some elderly households will surely remain loyal to wireline services, our research provides no indication that elderly households are, as a group, unwilling or unable to shift from wireline to wireless services to satisfy their telecommunications needs.¹⁵

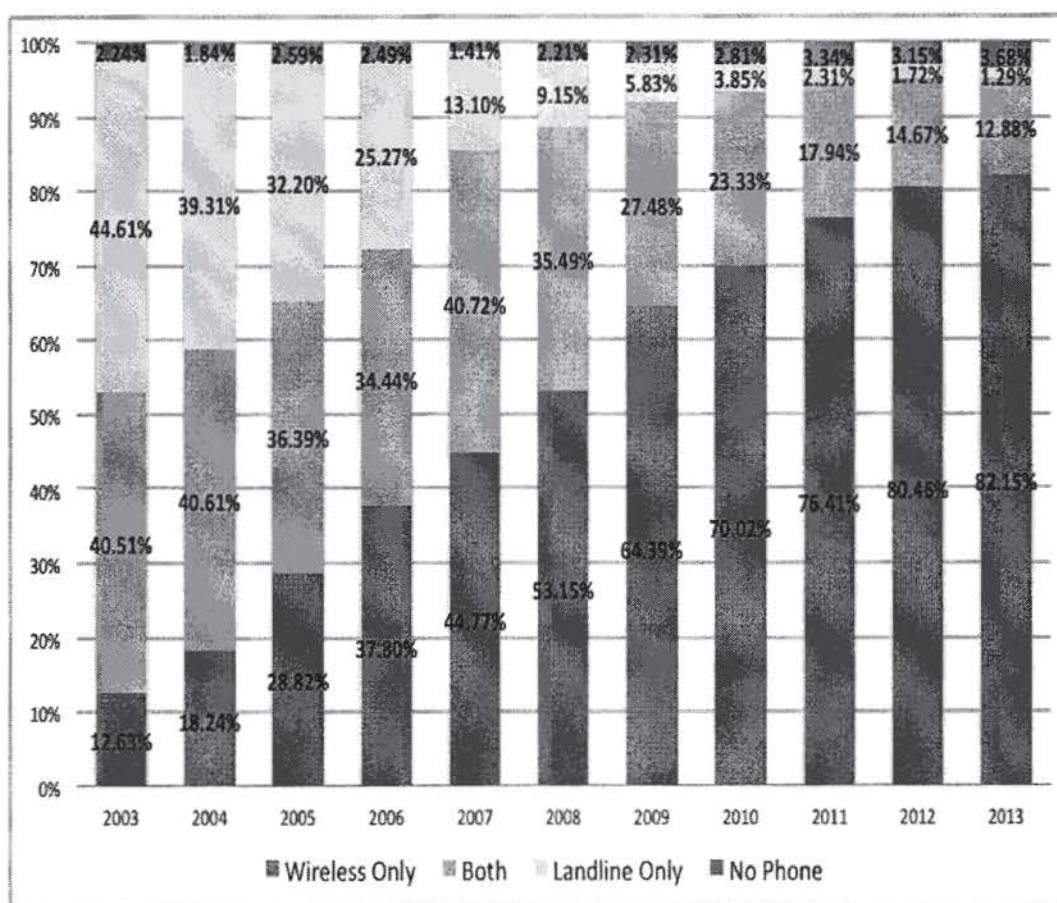
27. Another intriguing group of customers that merits focus as issues of relaxing regulation moves to the fore are young households. In particular, it is often observed that in matters of technology adoption, trends among young households are precursors to the behaviors that will spread to the larger population. In this context, examining consumption patterns among young households provides a window into the emerging future of telecommunications portfolios that the broad population will soon reveal.

28. Consider Figure 5. There we see that the share of households headed by young adults who rely exclusively on landline telephone service has fallen massively over the 2003-2013 period. By the end of 2013, only 1.3 percent of a young households relied exclusively on wireline telephone subscriptions to satisfy their telecommunications needs. The share of these households that rely on both wireline and wireless subscriptions has similarly declined dramatically. While over 40 percent of young households relied on both wired and wireless telephone subscriptions in 2003, that dual reliance had fallen to less than 13 percent by the end of 2013. Most dramatically, the share of wireless-only young-adult households grew to over 82 percent by the end of 2013. While the exact timing of the evolution of other households along this path is uncertain, the overwhelming demonstration by young households of the versatility and value of wireless communications relative to wired telephone service provides substantial

¹⁵ Moreover, as a practical matter attempts to target any such vulnerable groups are likely to be exceedingly difficult and costly, further reducing the likelihood that such groups are economically disadvantaged by pricing strategies of any supplier.

comfort to any concerns about the larger base of consumers being “locked-in” to wireline telephone service or subject to monopolistic price increases.

FIGURE 5
HOUSEHOLDS WITH WIRELINE, WIRELESS, BOTH OR NEITHER
AMONG HOUSEHOLDS WITH ALL MEMBERS UNDER AGE 31
2003-2013



29. While the descriptive statistics presented here provide substantial intuitive support for the proposition that wireless telephone subscriptions offer a substantive competitive alternative to traditional landline services, my research efforts have probed this issue more deeply in

recent years. In particular, in Macher, et al. (2014), we develop an economic model of price and non-price determinants of consumers' telephone subscription portfolios.¹⁶ While the particulars of that paper are provided in Exhibit 2, it is important to highlight several aspects of the paper.

30. First, the theoretical framework for the paper is built upon a sound foundation of the microeconomics of consumer choice; highlighting the non-price characteristics of telephone alternatives (e.g., the quality of each offering), the non-price characteristics of households (e.g., their peripatetic tendencies), as well as price characteristics of each alternative. This framework provides a more complete foundation for understanding the *portfolio* of subscription choices of households than models that have traditionally focused on either the demand for wireline service or, alternatively, wireless service.

31. Second, our econometric approach adopts alternative approaches to estimate consumers' portfolio choices rather than imposing a single approach. The base model is one that envisions consumers making two interrelated decisions: whether to subscribe to wireline telephone service or not and whether to subscribe to a mobile telephone service or not. This conceptualization leads to a bivariate probit estimation which allows the two decisions to be statistically yoked. An alternative conceptualization envisions households making a single portfolio-choice decision: whether to subscribe to wireline telephone, a wireless telephone, both or neither. This frame for consumer decision-making leads to a mixed logit estimation. In both specifications we carefully employ modern econometric methods to ensure the integrity

¹⁶ This paper, appended as Exhibit 2, represents the most recent version of our research, which was first posted on the Social Science Research Network (SSRN) in August 2012.
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2133424.

of the resulting estimates. For example, we control in the estimation for the potentially confounding effects of the endogeneity of prices.

32. Third, the data we employ are both detailed and comprehensive. Our measure of consumers' choices for telephone service are drawn from a unique database developed by the Centers for Disease Control, who survey thousands of households annually on, *inter alia*, their portfolio of telephone subscriptions. While the publicly-available portions of his database are informative, we were able to secure approval from the National Center for Health Statistics to access the confidential locations of surveyed households. This then permitted us, in turn, to yoke household choices to other publicly-available data from a variety of sources.¹⁷ The result is a dataset that spans the 2003-2010 period with household-level observations for roughly 190,000 households. Our expanded dataset comprehensively incorporates measures of the prices faced by households, their incomes, the quality of wireline and wireless networks, network effects variables, demographic variables and measures of the degree to which household members are more or less closely affiliated with their domicile.

33. Finally, the results of our empirical inquiry are telling. Simple tetrachoric correlations between household subscription decisions for wireline and wireless services are negative and statistically significant at the 1 percent level, indicating that households that subscribe to a wireless service are less likely to adopt wireline telephony. Moreover, this pattern occurs for the entire period of the data and for each individual year in our sample. Additionally, the negative correlation in subscription decisions occurs at all income levels, with the largest negative correlation for the lowest income households. Because these observed correlations do not parse out individual effects of the various determinants of households' subscription

¹⁷ See footnote 10, *supra*.

decisions, we also employ modern discrete-choice econometric methods to illuminate the price and non-price determinants of households' decisions to subscribe to a wireline service, a wireless service, both or neither.

34. In all estimations, regardless of the specification, we find that prices of the relevant alternatives (wireless and wireline) are statistically significant drivers of consumers' choices of their telephone subscription portfolios. In particular, we find that the price of any alternative (landline or mobile) is negatively related to subscriptions to that service. That is, if the price of landline service were to be increased, the estimations robustly reveal that subscriptions to that service will decline. Importantly, this is after the econometric model has controlled for the independent influence of a host of other non-price determinants of consumers' demand. While this "own-price" effect is perhaps unsurprising, the estimation results also indicate that the price of any alternative (landline or mobile) is *positively* related to price movements of the other alternative. That is, price increases of landline telephone service are positively related to wireless telephone subscription. In the jargon of economists, the results reveal that wireline and wireless subscriptions are "substitutes" rather than "complements".¹⁸

35. The model estimates permitted us to explore the evolution of consumer behaviors to price changes. For instance, by bifurcating our sample into an early period (2003-2006) and a later period (2007-2010) we were able to estimate the impact of a price change of wireline service on consumers.¹⁹ The estimates reveal that in the early period changes in the price of wireline service precipitated only modest substitution by marginal consumers (i.e., those who would respond to a price change). Specifically, during the early period, only about one-half of

¹⁸ Our estimations also explored the sensitivity of this result among both elderly and poor households. While we find modestly more price sensitivity among young households, our principal results remain intact. For more details, see Macher et al. (2014), footnote 38.

¹⁹ Similar results occur with alternative bifurcations of the sample.

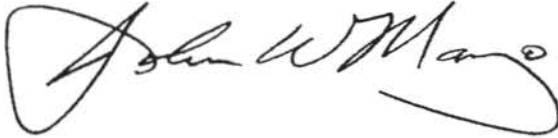
the marginal substitution was the result of households dropping their wireline service. Instead, while some consumers dropped their wireline service, a substantial share was prompted to experimentally adopt wireless service without disconnecting from their wireline service. In the later period, however, the estimates reveal that the marginal consequence of any wireline price change was predominantly to stimulate “cord cutting” behavior by households. This result is likely to have been driven by the substantial increase in the quality and versatility of wireless networks and devices.

IV. CONCLUSION

36. Regulatory policy changes are, appropriately, deliberate. When the Commission last examined the issue of wireline-wireless substitutability it cautiously pulled up short of recognizing the role of consumer substitution across these technologies. Today, however, a plethora of data and analysis reveal that wireless services present a substantive, viable and economically constraining influence on the behavior of wireline telephone providers.

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I affirm that the foregoing is true and accurate to the best of my knowledge.

A handwritten signature in black ink, appearing to read "John W. Mayo". The signature is fluid and cursive, with a large loop at the beginning and a long, sweeping underline.

John W. Mayo

October 6, 2014

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Exhibit 1

VITA

JOHN W. MAYO

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McDonough School of Business
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ACADEMIC APPOINTMENTS:

Georgetown University, McDonough School of Business

Professor of Economics, Business and Public Policy 1998-present

Executive Director, Georgetown Center for Business and Public Policy, 2002 – present

Dean, 2002-2004

Senior Associate Dean, 1999-2001

Georgetown University, Department of Economics

Professor of Economics (by courtesy), 2011-present.

Stanford University

Visiting Scholar, February 2013

Stanford Institute for Economic Policy Research

University of California, Berkeley

Visiting Scholar, January-May 2011

Haas School of Business

University of Tennessee, Knoxville

Professor of Economics, 1994-1998

Research Associate Professor, Center for Business and Economic Research 1989-1994

Associate Professor of Economics, Department of Economics, 1989-1994

Research Assistant Professor, Center for Business and Economic Research, 1981-1989

Assistant Professor of Economics, Department of Economics, September 1981-1989.

Virginia Polytechnic and State University (Virginia Tech)

Visiting Assistant Professor, fall 1983

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EDUCATION:

Honorary Doctorate in Economics, 2007, University of Basel, Basel, Switzerland

Ph.D., Economics, 1982, Washington University in St. Louis

Dissertation: "Diversification and Performance in the U.S. Energy Industry"

A.M. Economics, 1979, Washington University in St. Louis

B.A., Economics, 1977, Hendrix College, Conway, Arkansas

FIELDS OF SPECIALIZATION:

Industrial Organization

Regulatory and Antitrust Policy

Applied Microeconomics

Econometrics

NON-ACADEMIC APPOINTMENTS

U.S. Senate, Small Business Committee

Chief Economist, Democratic Staff, June 1984 - June 1985

International Institute for Applied Systems Analysis (IIASA)

Energy Research Fellow, Laxenburg, Austria, summer 1979

Transportation and Public Utilities Group

President, 2005-2006. President-Elect, 2013.

National Safety Council,

Board of Directors, Vice President, October 2002- 2006.

HONORS, AWARDS, AND GRANTS:

Undergraduate: Mosley Economics Prize (#1 graduating economics major), Alpha Chi (scholastic), Blue Key Honor Society, Senior Honors Seminar.

Graduate: University Fellowship, Washington University (1977-78); National Academy of Sciences Young Research Fellow, Laxenburg, Austria (1979); President, Washington University Economics Graduate Student Association (1979-81); Dissertation Fellowship, Center for the Study of American Business, Washington University (1980-81).

Post-Graduate: 2006 recipient of the Public Utility Research Center Distinguished Service Award; Zaeslin Fellow of Law and Economics, University, of Basel, Basel, Switzerland (2000 - present); William B. Stokely Scholar, College of Business Administration, The University of Tennessee (1993-1995); South Central Bell Research Grant (1988); Research Affiliate, Center of Excellence for New Venture Analysis, The University of Tennessee (1985); Summer Faculty Research Fellowships, The University of Tennessee (1983-1985).

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COURSES TAUGHT:

Undergraduate: The Miracle of Markets?, Principles of Microeconomics, Economic Foundations of Commerce, Current Economic Problems, Government and Business, Intermediate Microeconomics, Energy Economics

Graduate: Managerial Economics (MBA), Firm Analysis and Strategy (MBA), Managing in a Regulated Economy (MBA), Economics (Executive MBA), The Economics of Strategy (MBA), Business and Public Policy (MBA), Competition and Competition Policy (MBA), Regulation and Deregulation in the American Economy (MBA), Strategic Pricing: Theory, Practice and Policy (MBA), Understanding International Business (MBA), Industrial Organization and Public Policy (Ph.D.), The Economics of Antitrust and Regulation (Ph.D.)

PUBLICATIONS:

A. JOURNAL ARTICLES

“Revenue Adequacy: the Good, the Bad and the Ugly” (with Jeffrey T. Macher and Lee F. Pinkowitz), Transportation Law Journal, forthcoming.

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B. BOOKS, MONOGRAPHS, AND OTHER PUBLICATIONS

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Deregulation and Market Power Criteria: An Evaluation of State Level Telecommunications Policy" (with David L. Kaserman) in Telecommunications Deregulation: Market Power and Cost Allocation Issues, J. Allison and D. Thomas (eds.), Quorum Books, 1990.

The Economics of Local Telephone Pricing Options (with J. E. Flynn), Center for Business and Economic Research, The University of Tennessee, October 1988.

Firm Entry and Exit: Economic Linkages in Tennessee (with J. E. Flynn), Center for Business and Economic Research, The University of Tennessee, Knoxville, July 1988.

"The Economics of Regulation: Theory and Policy in the Post-Divestiture Telecommunications Industry" (with David L. Kaserman) in Public Policy Toward Corporations, Arnold Heggstad, editor, University of Florida Presses, 1988.

"Entries and Exits of Firms in the Tennessee Economy: Foundations for Research," Survey of Business, The University of Tennessee, Vol. 23, Summer 1987, pp. 21-23.

"The Relationship of Manufacturing and Nonmanufacturing Firm Entry and Exit in Tennessee" (with Joseph E. Flynn), Survey of Business, The University of Tennessee, Volume 23, Number 2, Fall 1987, pp. 11-16.

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Entries and Exits of Firms in the Tennessee Economy (with W. F. Fox, et al.), Center for Business and Economic Research, University of Tennessee, Knoxville, May 1987.

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"An Economic Analysis of a Monitored Retrievable Storage Site for Tennessee" (with W. F. Fox, L. T. Hansen, and K. E. Quindry), Final Report and Appendices, December 17, 1985.

CONGRESSIONAL AND REGULATORY TESTIMONIES:

U.S. Senate (Commerce, Science and Transportation Committee; Energy and Natural Resources Committee, Subcommittee on Water and Power); Federal Communications Commission; U.S. International Trade Commission; Tennessee State Legislature (Senate Finance, Ways and Means Committee; Special Joint Legislative Committee on Business

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Taxation; and, Senate State and Local Government Committee); Maryland State Legislature (Environmental Works Committee); Pennsylvania Public Utility Commission; Michigan Public Service Commission; Missouri Public Service Commission; Illinois Commerce Commission; West Virginia Public Utility Commission; Wyoming Public Utility Commission; Washington Utilities and Transportation Commission; Utah Public Service Commission; Wisconsin Public Service Commission; California Public Utilities Commission; Florida Public Service Commission; Delaware Public Service Commission; Montana Public Service Commission; Maryland Public Service Commission; Massachusetts Department of Public Utilities; Georgia Public Service Commission; Colorado Public Utilities Commission; North Carolina Public Utilities Commission; Missouri Public Service Commission; Texas Public Utility Commission; Arkansas Public Service Commission; Connecticut Department of Public Utility Control; Kansas State Corporation Commission; and New Jersey Board of Public Utility Commissioners.

INVITED SEMINARS AND SELECTED CONFERENCE PRESENTATIONS:

Columbia University, University of Chicago, London Business School, University of Paris (Dauphine IX), Vanderbilt University, INSEAD, Washington University in St. Louis, University of Michigan, Ohio State University, University of Minnesota, University of Florida, University of Arkansas, University of Texas, University of Missouri, Florida State University, Rutgers University, American University, University of Missouri, Kansas University, University of Utah, University of Colorado, University of Basel (Switzerland), University of Freiburg (Germany), University of Central Florida, American Enterprise Institute, Brookings Institution, Federal Communications Commission, Australian Competition and Consumer Commission (ACCC), Telecommunications Policy Research Conference (TPRC), National Conference of State Legislatures, U.S. Advisory Commission on Intergovernmental Relations

SELECTED CONSULTING:

U.S. Department of Justice, Antitrust Division; U.S. Federal Trade Commission; AT&T; Sprint; MCI Telecommunications; Verizon; Optus Communications (Australia); United Parcel Service; Commonwealth of Virginia, Tennessee Valley Authority; Antitrust Division, Office of the Attorney General, State of Tennessee; U.S. Senator Howard Baker, Jr., U.S. Senate Majority Leader; Oak Ridge National Laboratory; AmerenUE; Arkansas Consumer Research; Division of Energy Conservation and Rate Advocacy, Office of the Arkansas Attorney General; U.S. Department of Energy

PROFESSIONAL PRESENTATIONS:

American Economic Association Annual Conference, Western Economic Association Annual Conference, Southern Economic Association Annual Conference, European Association for Research in Industrial Economics Annual Conference, Center for Research in Regulated Industries Eastern Annual Conference, Center for Research in Regulated Industries Western Annual Conference, Southeastern Economic Analysis Conference

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WORKING PAPERS:

“Demand in a Portfolio Choice Environment: The Evolution of Telecommunications” (with Jeffrey T. Macher, Olga Ukhaneva and Glenn Woroch).

“Can you Hear me Now: Exit, Voice and Loyalty Under Increasing Competition” (with T. Randolph Beard and Jeffrey T. Macher).

“Targeting Rivals: Moving from ‘Whether’ to ‘Whom’” (with David E.M. Sappington).

“Employing Auctions to Allocate Scarce Resources” (with David E.M. Sappington).

“Now It’s Getting Personal: Universal Service in a Wireless World,” (with Jeffrey T. Macher Olga Ukhaneva and Glenn Woroch).

EDITORIAL REVIEWER:

National Science Foundation, Brookings Institution, Federal Trade Commission, The MIT Press, American Economic Review, Quarterly Journal of Economics, Journal of Law and Economics, Economic Journal, Journal of Business, RAND Journal of Economics, Journal of Regulatory Economics, Review of Economics and Statistics, Economic Inquiry, Journal of Industrial Economics, Journal of Economics & Management Strategy, Journal of Law, Economics and Organization, Journal of Economic Behavior and Organization, Review of Industrial Organization, Scandinavian Journal of Economics, Eastern Economic Journal, Southern Economic Journal, Contemporary Economic Policy, Economic Development and Cultural Change, Industrial Relations, Growth and Change, Review of Regional Studies, Journal of Economics and Business, Quarterly Review of Economics and Business, Journal of Policy Analysis and Management, Quarterly Journal of Business and Economics, Regional Science and Urban Economics, Financial Review, Journal of Money, Credit, and Banking, Social Science Quarterly, Telecommunications Systems, Public Finance Quarterly, Japan and the World Economy, Energy Economics, Information Economics and Policy

EDITORIAL AND ACADEMIC OVERSIGHT BODIES

Associate Editor, Information Economics and Policy, 2007-2011.

Editorial Board, Journal of Regulatory Economics, 1999-present.

Editorial Board, Review of Industrial Organization, 2002-2003; 2010-present.

Associate Editor, Economic Inquiry, 2013-present.

Board of Academic Advisors, The Free State Foundation, 2008 – 2009.

Research Advisory Committee, National Regulatory Research Institute (Ohio State University), 1993-1997.

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PROFESSIONAL MEMBERSHIPS:

American Economic Association
Western Economic Association
Southern Economic Association
American Law and Economics Association
International Telecommunications Society
European Association for Research in Industrial Economics

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Exhibit 2

Demand in a Portfolio-Choice Environment: The Evolution of Telecommunications

Jeffrey T. Macher *

John W. Mayo*

Olga Ukhaneva*

Glenn A. Woroch †

Abstract

We explore the pattern and evolution of the rapidly changing landscape of consumers' wired and wireless telecommunications choices with a model that extends the traditional (node-to-node) demand structure. We then empirically estimate a consumer choice model using household-level observations from 2003-2010. Households that are more affiliated with their domicile are more prone toward wireline services while more "on the go" households are more attracted to wireless telephony. The estimations indicate that subscription to wireline and wireless telephony are substitutes rather than complements. Finally, the quality convergence in wireless and wireline services has contributed significantly to shifts in consumers' telephone portfolios.

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